# THE MODEL ENGINEER

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# Smoke Rings

**A Victoria Club Regatta**

I HEAR that as the result of the recent meeting of the members of the Victoria Model Steamboat Club, a regatta will be held on the Bathing Lake, Victoria Park, on Sunday, June 21st, racing to begin at 12 noon. No entry forms are required, but all power boat owners will be welcome, and the various events will be arranged to suit the boats available. The main object of the regatta is to provide an enjoyable reunion of power boat men, and it is to be hoped that the weather and the attendance will combine to make this event a very successful affair.

**A Toronto Display**

JUST after I had written my recent note about clubs carrying on, my mail brought me an interesting letter from Mr. Lawrence G. Bateman, Vice-President of the Toronto Society of Model Engineers. He reports that this Society is still very much alive. He says: "Many of our members are entirely engaged on war work; some of them are unable to attend meetings, due to night work, and a few are in the Forces. However, we still meet every three weeks, and have an attendance of about fifty." This is not all the good news from Toronto, for the members recently thought they could do something to help the war along by raising some money through an exhibition. They achieved a remarkable success. They obtained permission to use the arena in the Canadian National Exhibition Coliseum Building, and the Royal Canadian Air Force supplied them with nearly eighty tables, and gave substantial help in building a passenger-carrying track for 3½-in. gauge locos. At first it was thought that it would be difficult to fill such a large space with both models and public, but in the result it proved to be exactly right. The Hamilton and Montreal Societies both sent some fine models, and a locomotive came from Winnipeg. In three afternoons and evenings 1,600 dollars were taken in all. A raffle for a large model schooner presented by Mr. Sam King produced 446 dollars, and rides on the track at 10 cents per trip raised more than 50 dollars. Admission to the show was 25 cents for the general public and 10 cents for those in the Forces. The money, less some very small expenses, was devoted to the R.C.A.F. Benevolent Fund, and the British War Victims Fund, associated with the Lord Mayor's Fund. I am promised some photos. and fuller details of this fine Toronto effort in due course, and I shall look forward with much interest to their arrival. Mr. Bateman adds that the show went without a hitch of any kind, and another show next year is already being discussed. This suggestion came from the public, who obviously enjoyed the show to the full. Bravo, Toronto!

**The Model "Royal George."**

MANY readers have supplied the information which we asked for concerning the model locomotive *Royal George*, of which we published a photograph in our issue for May 21st last. All these readers are cordially thanked for their promptness in replying to the question raised in the article. The model was to be seen, before the war, in the Science Museum, South Kensington; it seems to have been built in 1830, by Thomas Taylor and William Serginson, who were, respectively, foreman fitter and turner at the Shildon works of the Stockton and Darlington Railway, and there can be little doubt that its construction was supervised by Timothy Hackworth himself. It obviously represents the original condition of the *Royal George*, though there is still some evidence of model makers' "licence" in most of the working parts. The surmise that the photograph is official is correct; it is one of a series issued by the authorities of the Science Museum, to whom due acknowledgment is now made.

Percival Marshall

## *Model Aeronautics

# An Early "Wright" Biplane

**Mr. Lawrence H. Sparey, in this instalment, deals with the skids, pilot's seat and rudder for a solid, scale, working model**

AS mentioned in a previous article, the "Wright" biplane was not, at first, fitted with a wheeled undercarriage, but possessed a pair of skids which were swept upwards at the front to carry the elevator. These skids may now be made and fixed to the model, and the photograph, Fig. 14, shows the framework thus completed. Fig. 15 gives details of the arrangement of one of the skids and its bracing struts, and two such assemblies are required. The skid itself [marked (A)] is bent in the steam from a kettle from a length of 1/16 in. × 1/16 in. birch or spruce, to the mild curve shown. It will be as well to make a full-sized drawing of the skid so that the piece of birch may be bent and laid upon the drawing to ensure that the curve conforms. The best plan is to bind two lengths of birch together with cotton, and to bend both pieces at one operation. This ensures that both skids will be alike.

When bent, fix one skid to the drawing with pins, and cement the short upright (E) in the position shown. Now add the bracing strut (D), and the two struts marked (F) and (G). Ignoring all other struts for the moment, cement in the small corner blocks, which may be cut from 1/16 in. sheet balsa or basswood. Make a similar assembly for the other strut, and lay aside for an hour or two for the cement to set.

The portion of the drawing in dotted line represents a section of the wing structure which we have already made, and shows the position in which the undercarriage is cemented. Lay the wing upside down upon the table and cement the undercarriage to it, checking that the undercarriage supports are at right-angles to the wing. They may be secured by means of pins until the cement is hard. When set enough to handle, two cross-bracing struts are added beneath the wing, as may be seen in Fig. 16. This drawing represents a view of the undercarriage from the front, and should be viewed in conjunction with the photograph and Fig. 15. In Fig. 15 will be seen a spar in dotted line marked (H), which is one of the two bracing struts shown in full line in the front view in Fig. 16. In the photograph (Fig. 14), one of these struts, marked (H), may be seen beneath the wing, and it will be noted that they run from the skid to the centre of the lower wing.

The skids may now be joined together at the front tips by means of a cross spar, marked (J) in the photograph. Also, a similar cross spar is cemented at (K), and another between the skids directly beneath the leading edge of the wing. Struts (B) and (C) are now added. These are of ⅛ in. × 1/16 in. birch, spruce or basswood, while all

* Continued from page 509, "M.E.", May 28, 1942.

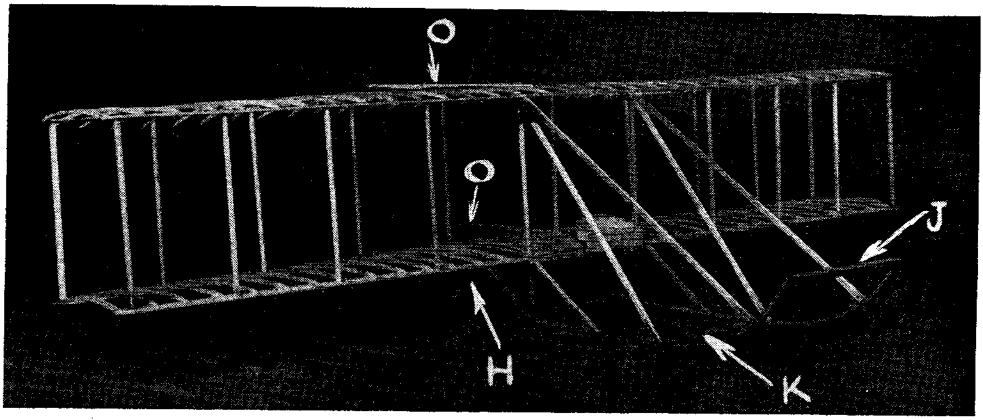



**Fig. 14. Biplane structure with outriggers and tail-booms attached.**

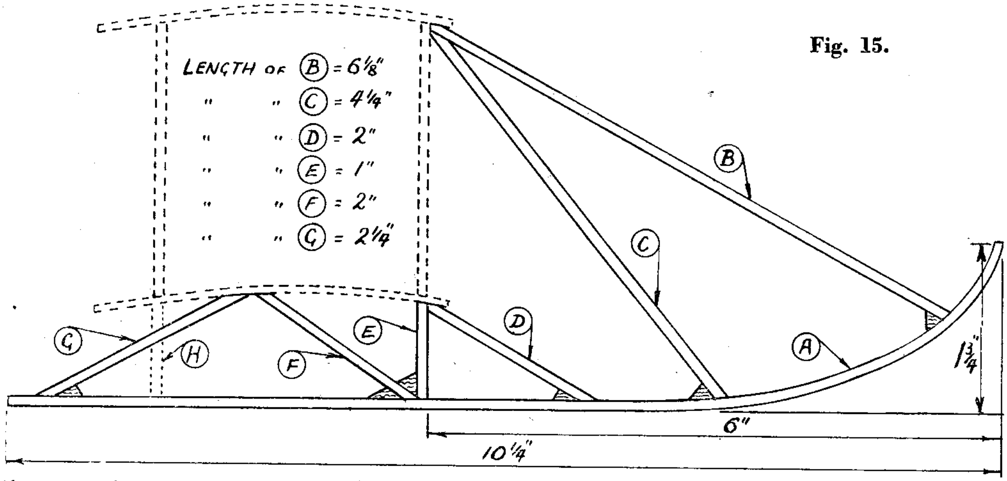



Fig. 15.

the rest of the undercarriage is of 1/16 in. × 1/16 in. similar wood. All the small corner blocks, as shown in Fig. 15, should now be cemented into place. On looking at Fig. 16 it will be seen that there are also

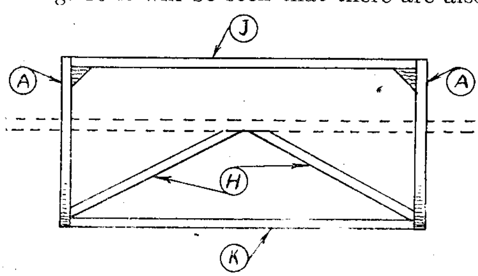



Fig. 16.

two corner blocks at the junctions of the skids (A) and the cross member (J).

I was at some pains to make the small metal fishplates, which are plainly seen in the photograph at the junctures of the spars and the skids, and also at the joint between the top wing and the forward supports. After trials with tinfoil and other methods, I concluded that the only way to make "real" looking plates was to shape them from thin sheet aluminium (about 3-thousandths of an inch in thickness) in the manner of the full-sized machine. While entailing a lot of work, the results justify it. Fig. 17 shows one of these plates cemented on to a joint, and also gives an idea of the development. The dotted lines show where the plates are folded to enclose the spars. The shapes will, of course, vary with the particular joint to be covered, so that it will be advisable to cut a separate template for each from paper, which may be manipulated over the joint in question, the exact shape thus being easily obtained. The plates are fixed to the spars with cellulose cement, and, when in position, the rivets may be successfully imitated by denting the aluminium with the point of a scriber. They are seen quite well in Fig. 14.

At this stage, we may fix the pilot's seat, which is quite a simple, wooden affair. In fact, little regard was given in those days to the comfort of the passenger, and I have a book written at the period which rather quaintly suggests that a windscreen would greatly add to the comfort and lessen the fatigue of the pilot. Piloting a plane at that time was a job for strong men, and a flight of an hour was an exhausting business. Not only were brain and muscle constantly engaged upon holding the machine upon its course, but the bark of the engine and the racket of the transmission chains as they rattled through the tubes, coupled with the continual screaming and buffeting of the wind, must have been a most nerve-racking experience.

The left-hand drawing in Fig. 18 shows the development of the seat. Cut a half

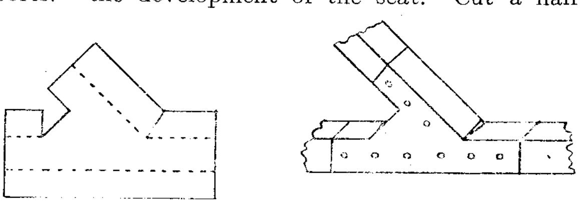


Fig. 17.

circle of balsa or basswood to the radius shown; then form the back from another piece of wood, with the grain running in the direction shown; then cement the back to the edge of the semi-circle, and the seat is made. Now cement it to the centre portion of the wing, close up to the right-hand

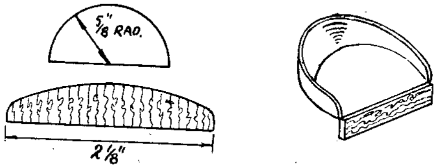



Fig. 18.

front wing strut, as shown in the photograph, and add the small wooden skirt to the front of the seat.

At the rear of the machine lies the rudder, which is hinged between two spars extending backwards from the centres of the wings, and at this stage the spars may be fixed in place. Fig. 19 gives the necessary sizes, and shows the manner of fixing. Two lengths of bamboo are shaped to a square section of about ⅛ in. by ⅛ in., and the corners rounded over with glasspaper. Each is then cut to 5½ in. in length. In machines of the 1910 period a great number of the spars were of bamboo, and in model work the " knots " or ridges which bamboo possesses must be imitated. A successful method which I have used consists in binding thin strips of gummed paper tape at intervals along a spar, as shown in Fig. 19. Strips of the paper tape about 1/32 in. wide are wanted, and only two wraps need be made, as the knots must not be too bulky. Bind the strips along the spar at about ½-in. intervals, judging the spaces by eye so that a little natural-looking irregularity will be maintained. In the drawing, the knots have been shown larger than is necessary so that they may be more plainly seen.

Small bearing-plates, with a 1/32-in. hole bored in one end, are cemented to the ends of the spars. The drawing shows one of these plates enlarged. They are shaped from any odd piece of tin plate, and, after cementing, are further secured to the spar ends with a light binding of paper tape. The part of the drawing marked (X) represents the centre section of the wing, and it will be noted that the spars are cemented from a point 1¾ in. from the rear edge of the wing. A small packing-piece of wood is cemented beneath the spar to ensure that the spar projects horizontally from the wing top. On both top and bottom wings the spars are cemented to the top wing surface, as may be seen in Fig. 14, maked (O), which shows how your structure should appear at this stage.

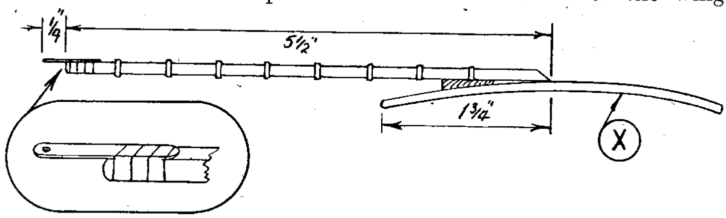
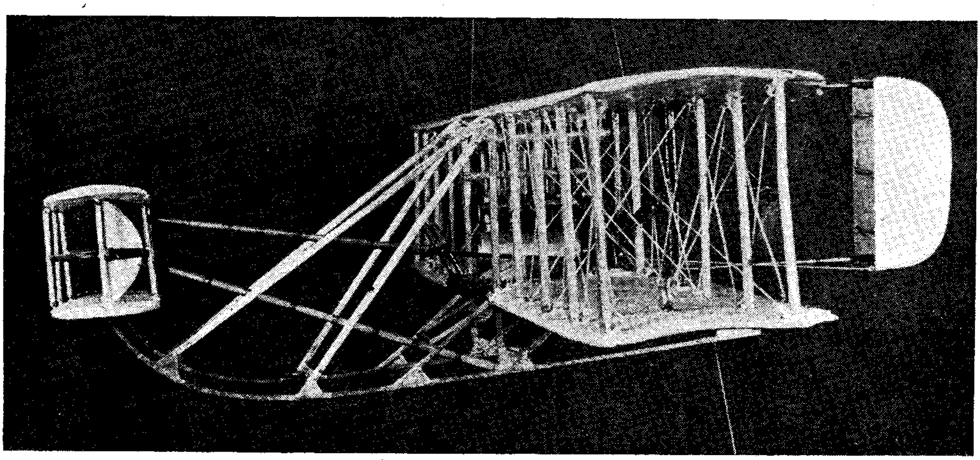



Fig. 19.



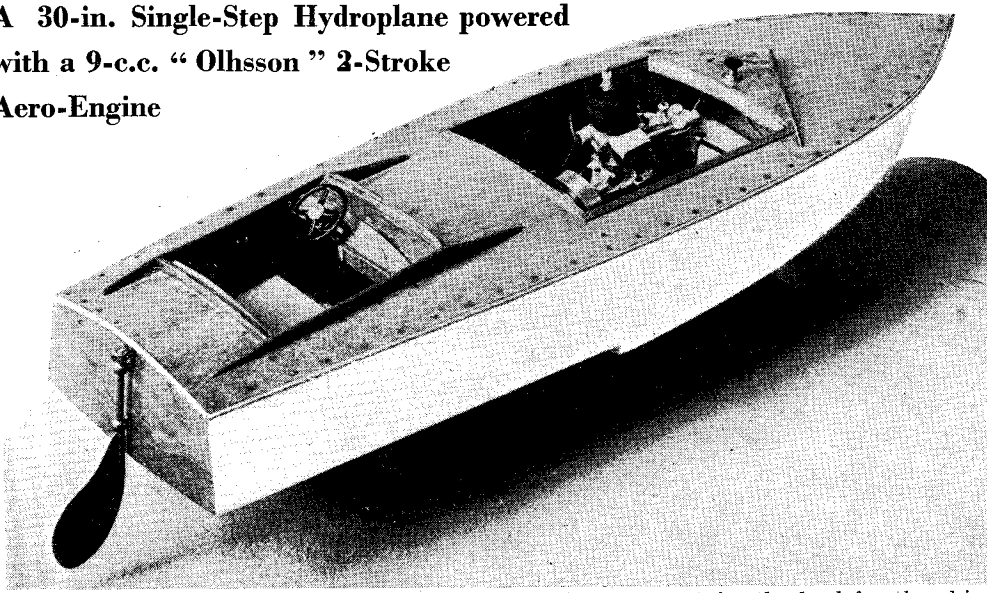
**Side view of the model, showing the details described.**

*(To be continued)*

# "DOLLY"

By A. Galeota

## A 30-in. Single-Step Hydroplane powered with a 9-c.c. "Olhsson" 2-Stroke Aero-Engine



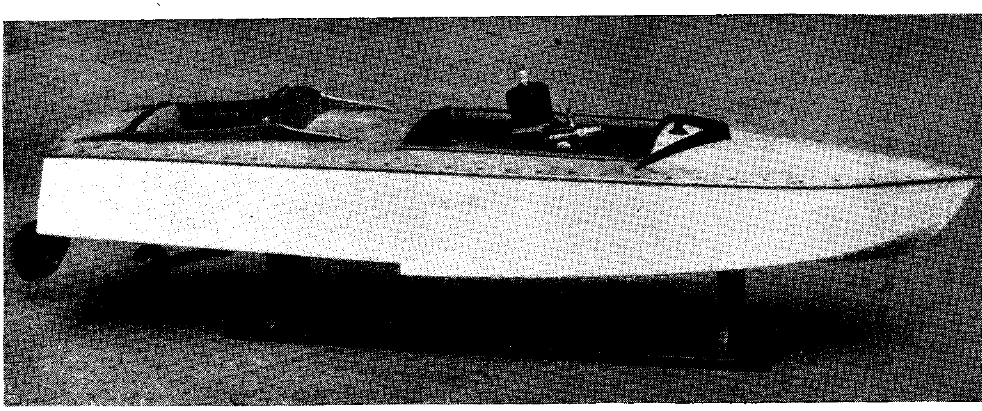
THE design of this boat was evolved from the well-known $1\frac{1}{2}$-litre "Whippet" class racing hydroplane, the sheer plan being identical to the original, but the breadth has been proportionately reduced, and it is $9\frac{1}{2}$ in., length of the boat is 30 in.

The hull is built in rather an unorthodox manner, a central backbone keel (of $\frac{1}{2} \times \frac{3}{4}$ in. thick) was laid down. The stem and transom with knee fixed in place in the usual manner, and notches were cut in the keel and slots in the stem for the planking. All these parts were made of soft mahogany. At this stage the hole for the propeller shaft was drilled and the step fixed. Next the moulds were cut (6 in all) including transom, tapered at both ends of the boat and notches were cut for the keel for the chines and gunwale strakes.

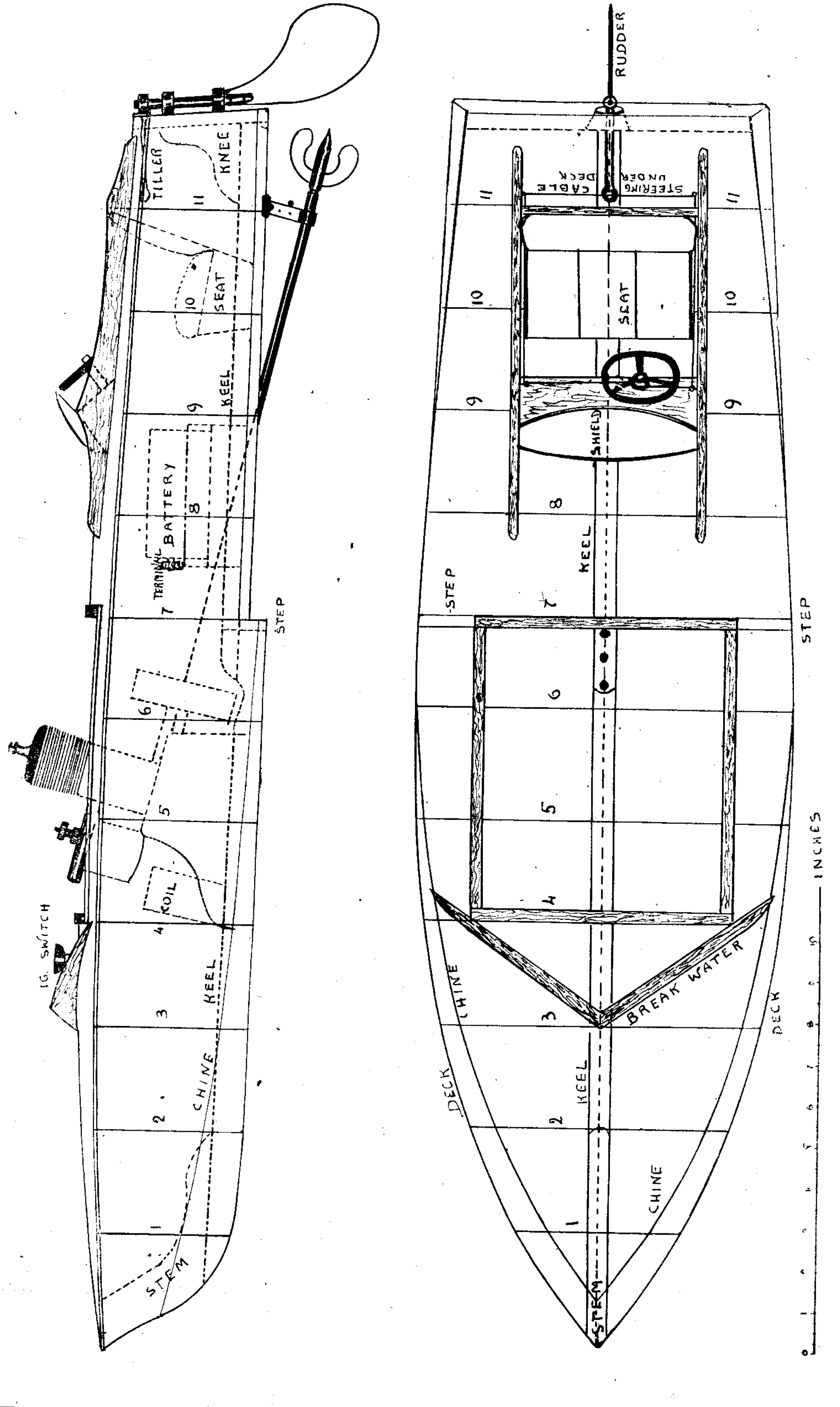
These moulds were erected on the keel and firmly fixed to keep in the desired position, by three longitudinal strips on top, as usual.

The chines (of $\frac{1}{4}$-in. square birch) and gunwale strakes, also of same thickness, were then fixed in position and firmly screwed and cemented to the stem and transom. The two side planks of $\frac{1}{8}$ in. thick mahogany ply were cut, with the help of cardboard patterns, steamed and fixed in place, cemented and screwed to the stem and transom and to chines and gunwale strakes, and, where required, provisionally screwed to the moulds.

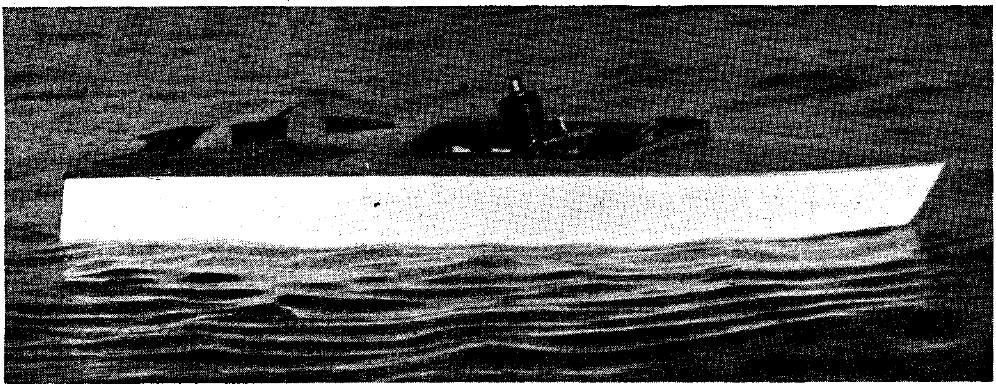
The floor was dealt with in the same



A 30-in. single-step hydroplane.




Elevation and plan of the 30-in. single-step hydroplane.

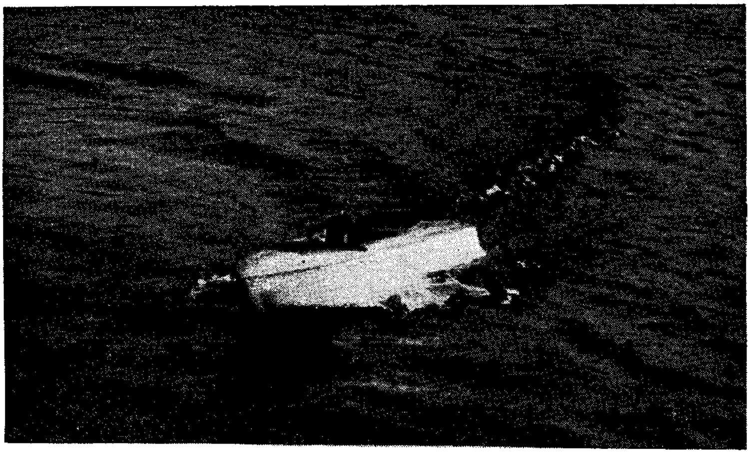


"Dolly"—Just floating.

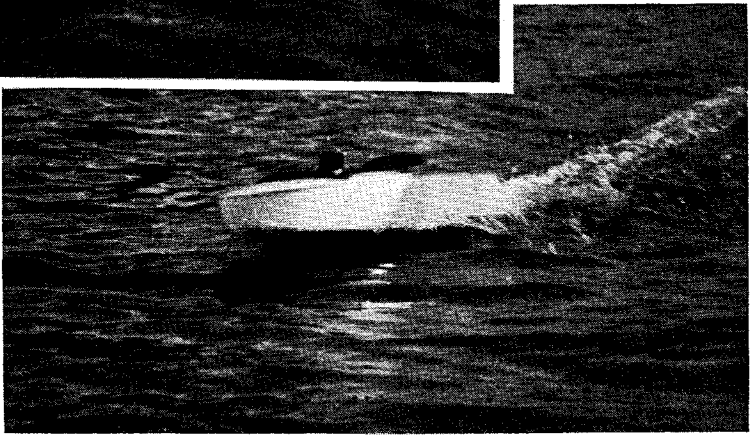
manner, consisting of four pieces of $\frac{1}{8}$-in. thick mahogany ply also, and screwed and cemented to the keel.

The next operation consisted in fixing the beams and ribs, removing the moulds. At section 1 and 2 solid ribs were cut to the shape of the floor and to compel the latter to the desired curve, screwed, of course, to the keel planks and chines; from chines to the gunwale strakes they were made of two separate pieces each. At the remaining sections all ribs were made of four pieces. Two pieces on each side (cemented and glued to the planks) between gunwale strakes and chines, and two pieces, as above, wedged between chines and into the notches of the keel. After all moulds had been removed and beams and coamings fixed in place, a really strong and nice looking hull was obtained.

The inside of the hull was painted with two coats of white lead paint and one coat



Left—At half speed.



Right—At full speed.

of Vesta lacquer (eau de nil colour). The deck, 1/16 in. thick ply, was cemented and screwed in place, $\frac{1}{8}$-in. brass screws, one inch apart, were used and all countersunk. The deck was varnished with two coats of copal clear varnish. The hull was painted with several thin coats of white lead paint, rubbed down between each coat, and one final coat of white Vesta lacquer, giving to the boat a really beautiful finish.

I shall not describe the engine, which, being a commercial one, most readers will already know, but will only say that the shaft, with roller bearing, provides really smooth running, producing a thrilling note. The propeller shaft is provided with ball-bearing at the engine end, and the propeller is a Stuart Turner of $1\frac{5}{8}$ in. diameter. There is no skeg and the drive is direct.

The rudder is made of brass and is worked by a Meccano steering wheel in the driver's compartment, as illustrated. There is also an upholstered seat made of hard balsa wood. Also, the battery cage is made of hard balsa.

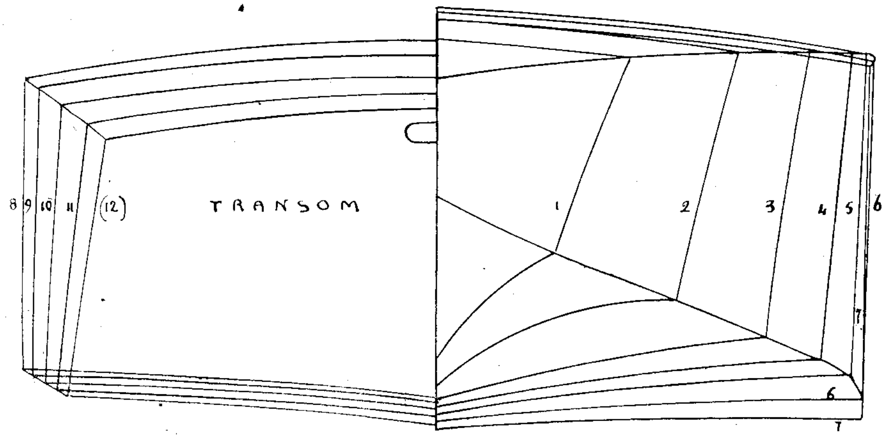
I use a 4.5 volt dry battery for ignition, Ever Ready N.126, the weight of which is about 12 oz., and gives a good many runs without replacing.

The model hydroplane ready to run should balance on the step, but is slightly heavy towards the stern.

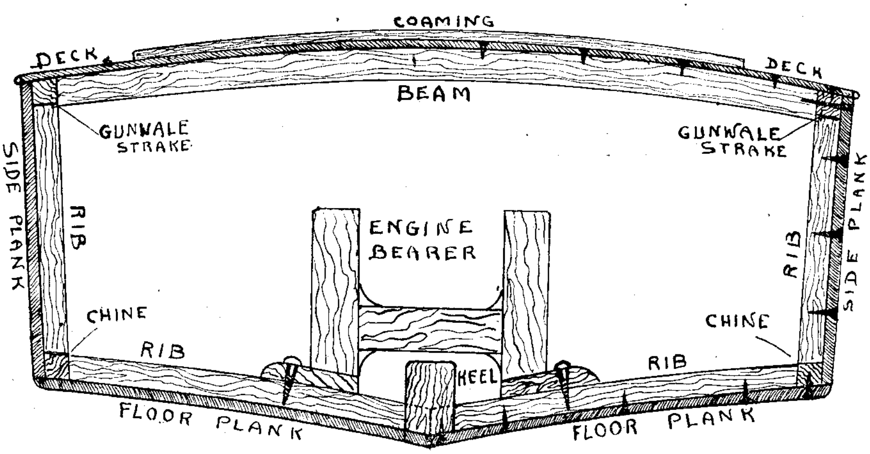
The complete weight of the model in running trim is about 6 lb., and can be released at full throttle even in considerably small ponds, and will steer steadily; but she will perform, of course, at her best on a wide circular course, attaining a speed of about 20 m.p.h.

After two seasons of extensive use, neither the engine, nor the hull, shows any sign of wear. She has always been let run untethered, and never caused the slightest

(*Continued on page* 563)




**Half-size body plan of "Dolly."**




**Section on (4) looking aft, showing constructional details.**

# *Small Capstan Lathe Tools

**Notes on "tooling up" for repetition work, with special application to the small capstan attachment recently described in the "M.E."**

By "NED"

THE cutting efficiency of taps and dies is a vital factor in rapid production, and it is more than likely that the reader whose screwing equipment is not of the highest quality may encounter difficulties in this respect. It is highly desirable, if not absolutely essential, that all threads should be completed in one cut; while it may be permissible to take more than one cut in certain circumstances (by using separate pre-adjusted dies, or by the use of taper, second and plug taps, all of which are fitted to their own holders, so that they can be slipped on the shank in turn as required), this method is bound to absorb more time than is desirable, and is likely to slow up output considerably in a long run. Sometimes, the best and quickest way, when two cuts are found necessary for clean and accurate screwing, is to make the finishing cut an entirely separate operation, re-chucking the parts after all other operations are completed, and holding the tap or die in a hand holder or die-stock, so that it can "float," in case the work does not run quite truly. But this is not always practicable, as the nature of the work may make re-chucking difficult.

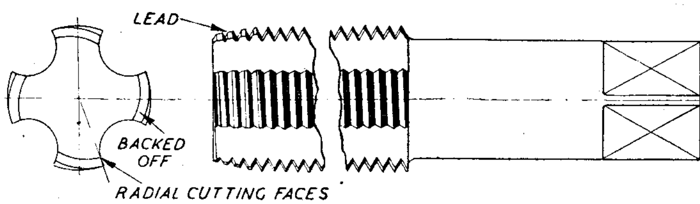



**Fig. 24. Enlarged view of small second tap, illustrating general characteristics. (Backing - off exaggerated.)**

One thing which definitely cannot be tolerated in capstan lathe practice is the "cut-and-try" method, in which the adjusting screws of the die have to be manipulated for each individual cut. Apart from the time factor, it would be extremely difficult to ensure uniformity of size in this way.

### Correcting Faults in Taps and Dies

Suppose that the only taps and dies available for the screwing operations in hand are of the "cheap and nasty" class, and will not cut a thread at one go without serious risk of jamming or stripping—what can be done about it? First of all, it is necessary to examine them minutely to ascertain the cause or causes of inefficiency. The main characteristics of ordinary taps and dies are illustrated in Figs. 24 and 25. If the thread faces, under inspection with a fairly high-power lens (such as a watchmaker's ocular) appear rough or ill-formed, or the points of the threads are worn away, there is little that can be done to remedy matters, and it is best to scrap the tap or die ruthlessly. An exception to this rule may be made in the case of a tool which is known to be of good quality originally, but has become blunted by continuous use, or by an attempt to use it on excessively hard material; it may be possible to re-condition this so that it is quite useful and efficient for a roughing process, though the incorrect thread profile may render it useless for finishing. There is, as a matter of fact, some advantage in roughing out threads to a shallow profile, and correcting the shape in a subsequent finishing process.

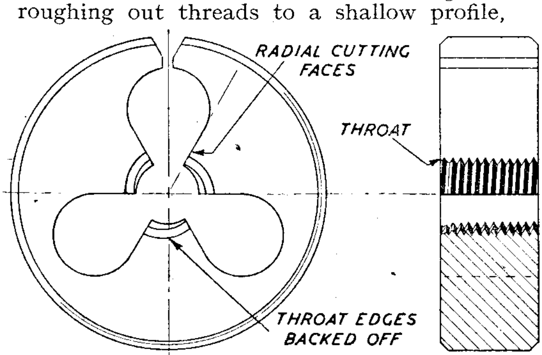



**Fig. 25. Enlarged drawing of small circular screwing die, illustrating general characteristics. (Backing-off exaggerated.)**

### Regrinding

Taps or dies which tend to jam are usually blunt on the cutting faces (the leading edges of the flutes), or the latter may

* *Continued from page* 526, "*M.E.*", *May* 28, 1942.

be incorrectly shaped, so that they cut inefficiently and do not clear the swarf properly. This will also have the effect of interfering with the thread already cut, and possibly cause stripping. Regrinding the cutting faces is the remedy in this case. It is not a difficult matter to grind the flutes of a tap, unless it is a very small one, but it requires the use of a grinding wheel of the correct shape, and preferably some form of jig or holder to ensure that the flutes are ground uniformly and to the correct angle. The ideal method, of course, is to employ a fully-equipped cutter grinder, but presumably few readers will have one.

Regrinding the die is a more difficult matter, as this can only be done by the insertion of a tiny wheel in the holes around the threaded bore. (See Fig. 26.) Suitable wheels are, however, available, usually mounted on arbors for use in small electric motor tools, or flexible shaft tools of the "dental drill" type; they must be run at extremely high r.p.m. to be effective, but this should not present an insuperable difficulty, even to those who do not possess the special equipment for which they are primarily intended.

It should be remembered that taps and dies, like all other cutting tools, work most efficiently when proper rake and clearance angles are observed; but in small dies, and most small taps, it is impracticable to back off the thread faces to produce proper clearance, and wear of the cutting face not only blunts the cutting edges, but also produces, in effect "negative" clearance. The rake angles of these tools, or at any rate the cheaper types, are often very inefficient, and this is where a great improvement can be made by regrinding.

If the cutting faces are exactly radial in either taps or dies, the effect is similar to that obtained by grinding a lathe tool dead flat on the top face—in other words, zero top rake. The cutting edge thus produced is durable, and will deal fairly effectively with materials which produce short chips; it is thus satisfactory for general purposes, where the rate of cutting is not excessive, and the chips can be broken by "backing out" from time to time. But if it is necessary to take a continuous cut, especially in tough material, this form of cutting edge is inefficient, and it is an advantage to grind the face so as to produce "top rake." The shape of the flute or slot should also be arranged so as to curl the swarf into tight coils, and thus facilitate its clearance from the work and the tool, instead of jamming it up. (See Fig. 26.)

**"Throat" and "Lead."**

Circular dies usually have the first two or three threads at the entering end bevelled away slightly to facilitate starting the die on a blank piece of work, and also to distribute the cutting load over several threads. This is usually known as the "throat" of the die, and is equivalent in its effect to the "lead" or taper of a tap. The longer the throat, the more gradual is the cutting action, and not only the wear on the die, but also the load imposed in the cutting operation, may be reduced by careful shaping at this point. If, however, the thread has to be cut close up to a shoulder, a long throat is not permissible, and in many cases it is necessary to use a die with hardly any throat at all. Sometimes this eventuality is met by reversing the die back to front, but it should be noted that a die which is ground to cut with maximum efficiency will not cut at all when reversed.

Similarly, a tap with a long lead or taper will cut very freely, as the cutting load is shared equally by a large number of teeth, but it is frequently necessary to use a "plug" tap, with practically no lead, in order to get right down to the end of a blind hole.

A slight backing-off of the throat or lead is beneficial to cutting efficiency, but should on no account be overdone, as it tends to make the die or tap cut too fiercely at the start, and thus produce a rough, eccentric or drunken thread.

**Prevention of Stripping**

The measures above specified will assist very largely to prevent the stripping of threads, but sometimes a die or tap which cuts efficiently in all other respects may still be an incurable "stripper." This is usually caused by seizure of the thread faces, or of minute particles of metal adhering to them and causing excessive friction on the finished work. The underlying cause is invariably roughness of the thread faces, which may be so slight as to be hardly perceptible on the closest inspection. Sometimes it may be cured by shortening the thread faces (i.e., widening the slots or flutes) but this also weakens the threads and thus may not always be desirable. Easing or rounding off the points of the threads at the trailing edges as shown in Fig. 26, nearly always helps, but it is a rather delicate operation, as it is so easy to run into the leading edges of the threads while carrying it out.

Very slight roughness of threads may be corrected by lapping, using a piece of soft metal such as copper or aluminium for a lap, and cutting a thread in or on it with the tap or die requiring treatment. The lapping should be carried out before grinding the cutting faces.

**Honing Taps and Dies**

It is possible to restore lost cutting edges on taps and dies by means of a honing slip of suitable shape and size. Fine grade carborundum or India oil-stone is suitable for this purpose, the latter being the more durable, but also slower in action. This process is applicable mainly to the " maintenance " re-sharpening of such tools; it is scarcely efficient enough for correcting cutting angles, or other drastic alterations, to put right errors as described above.

**Re-Tempering**

Sometimes taps or dies are found to be too soft or too hard to cut efficiently, and it is practicable to re-harden and temper them, so long as the steel they are made of is known, and due care is taken in the operation. If it is not certain whether they are of carbon or high-speed steel, the simplest way to find out is to use the " spark test," with the aid of a grinding wheel applied to some

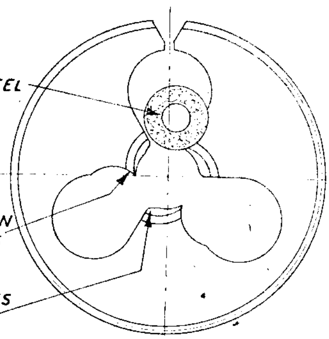



**Fig. 26. Showing how cutting faces of die may be ground to produce " top rake " by means of a tiny rotary grinding wheel. (Rake exaggerated.)**

part of the tool. As most readers are aware, carbon steel, when ground on a high-speed wheel, produces brilliant " rocket " sparks, while those emitted by high-speed steel are less profuse and spectacular, and dull red in colour. High-speed steel requires to be heated to a much higher temperature than carbon steel for hardening, and is generally most satisfactorily cooled off in an air blast. Carbon steel taps may be tempered in the same way as drills, end-mills and similar cutters; the shanks should always be " let down " beyond the blue, or in other words, dead soft. Dies of the same material, if made uniform in hardness all over, are liable to be brittle in the parts which are required to be flexible for adjustment; it is thus advisable first to harden them by quenching in thin oil, then polish the faces, insert a piece of screwed stock in the threaded part of the die, and lower it into a heated piece of tube to let down the temper. When the edges of the threads reach a light straw colour, quench out in water.

Even in normal times, when taps and dies of fairly satisfactory quality are obtainable very cheaply, it sometimes pays to spend some time in ensuring that they are in a condition to cut with maximum efficiency; and this care may save many times the cost of the tools in its ultimate effect on rapidity and quality of output. The elaborate directions given above for correcting the deficiencies of poor quality screwing tools will not therefore, it is hoped, be regarded as superfluous.

In cases where commercial taps and dies are not available at all, it is by no means out of the question to make them. Instructions for doing so have appeared in THE MODEL ENGINEER at various times, and it is known that some of these home-made dies have been quite equal in every respect to the average commercial product. There has long been a tendency in some engineering circles to rely on being able to obtain every tool and piece of equipment required through commercial supply channels, and while this is all right as long as it works, the policy tends to make one rather helpless when an emergency arises, and it is not possible to " reach everything down off the shelf." Model engineers have always been noted for resourcefulness and self-reliance, and these qualities are more than ever in demand under the present circumstances; never let it be said that they should fail to rise to the occasion.

*(To be continued)*

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## " DOLLY "

*(Continued from page* 560)

inconvenience. In the drawings, the wiring diagram and the water line have been omitted for clarity.

My idea in building this little craft was not with any purpose of racing or breaking speed records, but simply to have a boat realistic in appearance and performance, and I think I can claim to have obtained both such requisites.

This hydroplane can be confidently set to any desired circular course and will steer steadily without being tethered, and with no fear of a sudden change of her course planing at a speed of a good 20 m.p.h., and has given outstanding performance with very strong wind or current. I have launched her at full speed in the wake of a passing motor boat, and it was a great thrill to see her jump clean out of the water over the waves and still keep her deck dry and maintain her course.

# A Small Gear-Cutting Machine

Designed by T. P. S.

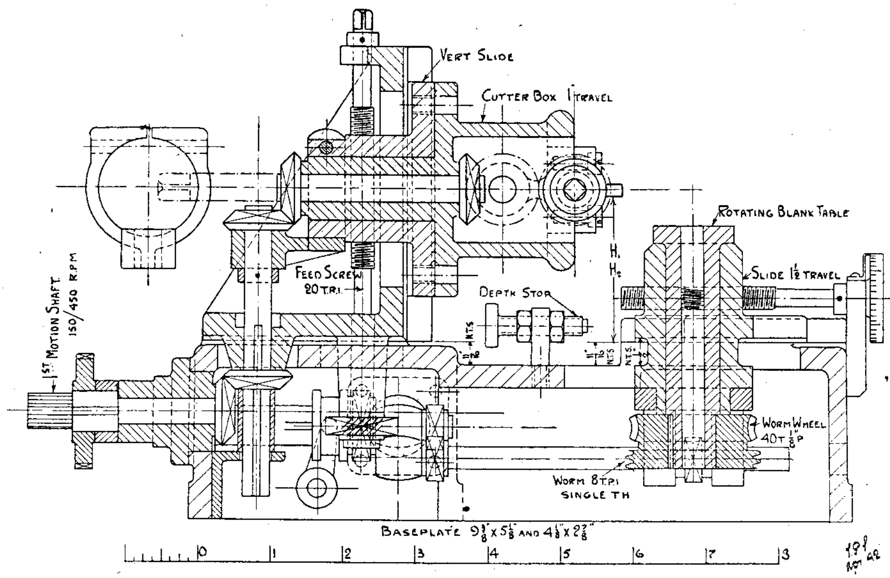



**Fig. 1. Sectional elevation, showing vertical slide and blank table.**

THE reproduced drawings show a design for a small gear-cutting machine having the necessary motions required in making gear wheels with straight teeth and worm wheels, and capable of using involute cutters for the first and hob cutters for both types.

In the second case, it should be noted that only one hob cutter is required for each pitch (normal), irrespective of the number of teeth to be cut and that no tooth-by-tooth hand dividing is necessary, as the blank is driven at a rate corresponding to the number of teeth required.

The hob cutter is also of a much simpler form than the involute, as the teeth are of a straight-sided rack form without any involved curves.

**Drive**

All the motions, driving the cutter, revolving the blank, and feeding the cutter

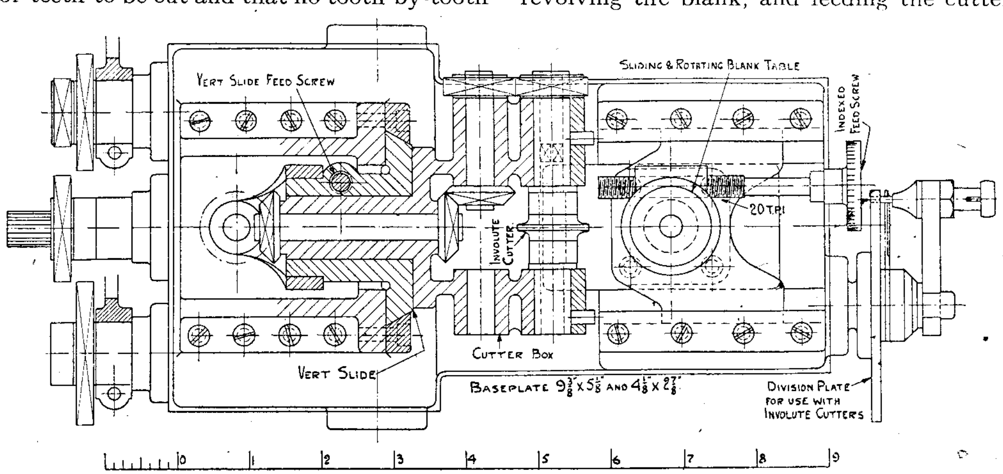



**Fig. 2. Plan with angle-bracket, slide and cutter box in section.**

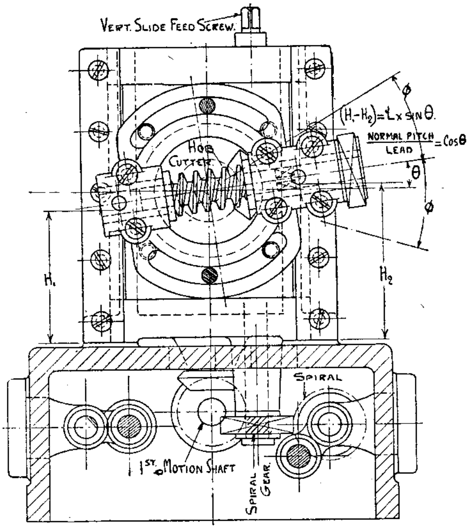



**Fig. 3. End view of angle-bracket and slide, showing cutter box and hob inclined for cutting straight teeth.**

across the blank originate from the splined first motion shaft.

This shaft is driven from a frame (not shown on drawing) having three stepped pulleys and backgear similar to the headstock of a lathe but with a smaller difference between the speeds, 25 per cent. increase on each step (1.95 to 1 backgear) is suggested, giving 150, 187, 235, 290, 365 and 450 revolutions per minute to the cutter, corresponding to 40, 50, 60, 75, 95 and 120 ft. per minute of a 1 in. diameter cutter.

The shaft of this frame is connected to the first motion shaft by an internally splined coupling which can be moved endways to enable the change-wheel to be altered through a small gap then expôsed between these shafts.

**Cutter Box**

The cutters are mounted on a short arbor having a square at one end, which square fits in a square socket in the hollow shaft running in the capped bearings of the cutter box.

The cutter box has a stem passing through a long boss extending backwards from the vertical slide and is capable of being rotated and locked at any angle from the horizontal in order to give the necessary inclination to

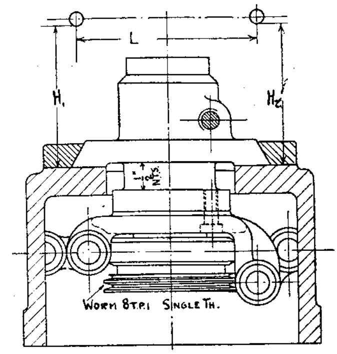



**Fig. 5. End view of blank table, showing worm bracket.**

the hob cutter to suit straight and possibly spiral-toothed wheels.

This angle is best set by the sine bar method as indicated on Fig. 3 ; $\theta$ is the angle required for straight teeth.

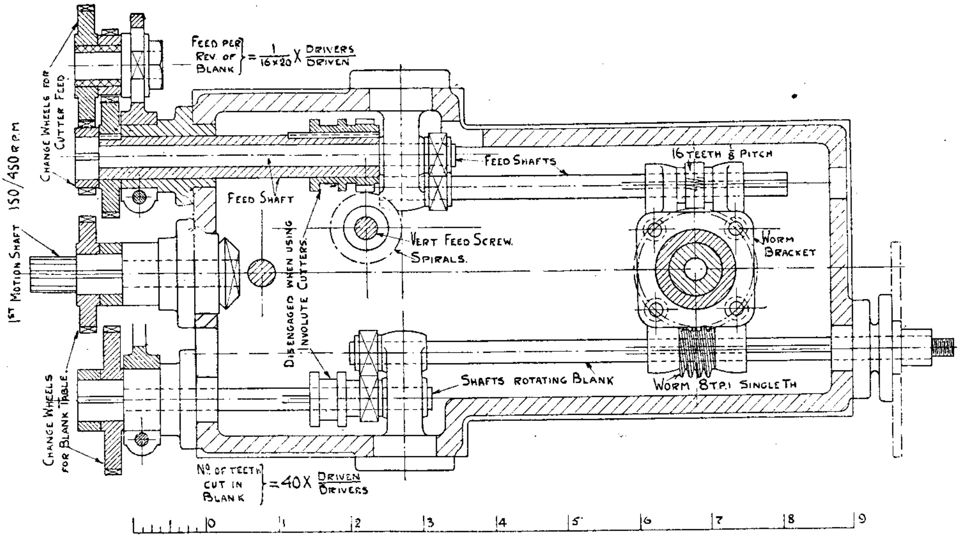



**Fig. 4. Sectional plan, showing rotating and feed mechanism.**

**Feed**

The vertical slide and cutter box are carried by the angle-bracket bolted to the baseplate and are given a vertical movement of 1 in. by the feed screw ; this feed screw is operated by hand when an involute cutter is being used and by the worm-driven feed shafts and change-wheels when a hob cutter is being used.

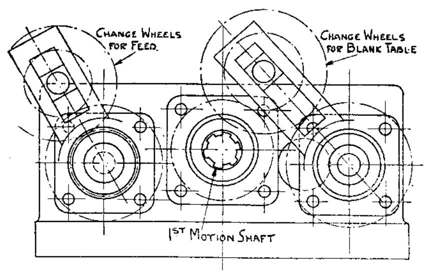



**Fig. 6. End view, showing change-wheels.**

With a 3 : 1 ratio of change-wheels a feed of 0.01 in. per revolution of blank, and with a 1 : 3 ratio a feed of 0.001 in. per revolution are obtained, with, of course, other rates of feed intermediate between these limits with other ratios.

**Blank Table**

At the opposite end of the baseplate is the sliding and rotating blank table to which the blank to be cut is secured by a central bolt with suitable washers for height and bushes for bore of blank.

This table is adjustable for position to suit diameter of blank and can be fed in for light cuts (if desired) and for depth of tooth by the indexed feed screw. It is revolved by the worm wheel fitted to its lower end, and the change-wheels driven from the first motion shaft at a rate to suit the number of teeth to be cut.

A single-thread worm integral with the above-mentioned worm wheel drives the feed screw of the vertical slide and cutter box.

**Involute Cutters**

When using involute cutters the shaft driving the worm wheel is disconnected from the first motion shaft, and is then revolved for each tooth to be cut by the dividing-plate mechanism shown.

**Worm Wheels**

When cutting worm wheels the cutter shaft would (usually) be horizontal and the vertical feed screw disengaged.

# HINTS ON SOLDERING ZINC

WHILE the soldering of zinc is comparatively simple, there are a few special points which should be noted in order to obtain the best results. Most soft solders contain a small amount of antimony ; a proportion of 1-2 per cent. of this element normally confers considerable benefits on the working properties and strength. Solders for zinc should have a low antimony content, however, on account of the interaction between these two metals.

In the soldering operation the molten solder alloys with the zinc and usually dissolves some of it. This action takes place rapidly when zinc is being soldered, and as a result much zinc may be dissolved by the solder. This can be shown by tinning a piece of sheet zinc and then wiping away the molten solder. If the tinning operation has been prolonged, it will be found that the zinc has been dissolved away to some depth below the level of the surface. A soft solder containing 40-45 per cent. tin, 0.5 per cent. antimony and the remainder lead will be found satisfactory for all zinc work.

When making joints on zinc with the copper bit, it is advisable to carry out the soldering operation as speedily as possible and to avoid overheating, in order to minimise the contamination of the solder as it is applied. Similar considerations apply to the soldering of galvanised iron and steel, which, of course, have a thin coating of zinc.

Dilute hydrochloric or spirits of salts is often used as a flux on zinc. This solution is very corrosive and requires great care in using it, as it is poisonous, and also injures the user's hands if brought into contact. It is much better to use an active flux of the chloride type, such as Fry's zinc flux. This flux exerts a rapid cleaning action and gives equally good soldering results, but the risk of corrosion is greatly diminished. Under some circumstances, however, the residue from such fluxes still causes discoloration or corrosion of the zinc. It is therefore necessary to wipe the soldered joint with a damp cloth, or to wash it well, preferably in warm water. On occasion, the nature of the work calls for a completely non-corrosive flux, and in such cases oleic acid is suitable.—A. J. T. E.

# THE SOUTHERN "Q1"

By "L.B.S.C."

SOME of the followers of these notes who have seen the pictures of the new Southern goods engine, No. "C1," in the daily press and elsewhere, have written for some information about a small replica, as they think it would be an easy subject to copy, having no running-boards and other impedimenta. Well, some folk have curious tastes, surely! But as I'm here to do my best to oblige everybody wherever possible, here goes for a few words on the subject. The engine is classed as "Q1," which in your humble servant's opinion, might be interpreted as standing for "queer one," which she certainly is; and the Company call it a "freight" engine. That is just one letter too many; leave out the "e" and you have a word which fits the engine exactly. When the official who was then Minister of Transport, inspected and took a ride on the same designer's streamlined passenger engine, he said that he considered the designer was an artist. I have a faint recollection about a similar compliment being paid to Mr. Epstein.

I saw the pictures in the daily press and also read the various notices accompanying them. When the said daily press "lets itself go" on technical matters, it beats comic papers to a frazzle. One journal vouchsafed the information that by leaving off the running-boards, cylinder flap, and "brass dome," a total of *twenty tons* had been saved in weight!! We live and learn, surely; it is news to me that running-boards and cylinder flaps were made from armour plating as used for battleships, tanks and so forth; and I *did* think that I knew a little about full-sized locomotive construction! Also, the last brass domes on the Southern lines were, to the best of my knowledge and recollection, fitted to the Wainwright engines of the S.E. & C.R. in the early years of the century. I also saw the engine herself; the first time, she was going down the bank, towards London, with steam on, which is very unusual, as all the goods trains are usually coasting easily when they pass the site of the Polar Route. Knowing what time any engines on trial usually make the return trip, I waited to see her go up the bank, and a sorry sight she was. With a train which would have been "easy meat" for a "K" or "N" class Mogul, she was making terribly heavy work of it, wheezing and snorting, with clouds of steam coming out from "the works," plus a sound as though the piston glands were blowing badly, or else the cylinder cover joints gone. I thought at the time, "Well, I shan't see you again for awhile, milady," and she has not been around here since, up to time of writing. Most engines, naturally, have "teething troubles," and they can be overcome; whether the design will prove a success or otherwise, is something which only time and service will determine. So much for that!

### Hints on a Small Edition

Readers who want to build a small "Q1" can refer to the outline drawing which can be "scaled up" to whatever size engine it is desired to build, and a good working locomotive obtained, despite the awful appearance, by making the inside of the boiler, the cylinders, and motion, all according to "live steam" specifications. As 2½-in. and 3½-in. gauges are the most popular at the present moment, according to my correspondence, here are a few items of information relating to those sizes. The frames on 2½-in. gauge should be 3/32 in.

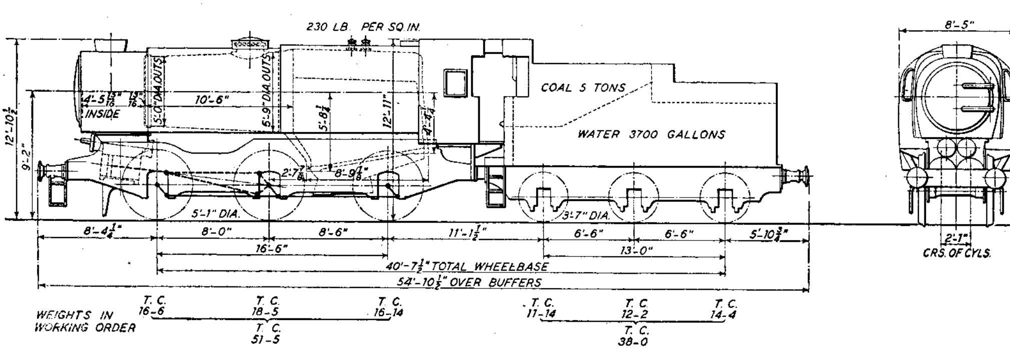



**Diagram of the S.R. "Q1" Class 0-6-0 engine, reproduced by courtesy of "Modern Transport."**

thick and on $3\frac{1}{2}$-in. gauge $\frac{1}{8}$ in., the overall widths being $2\frac{1}{8}$ in. and $3\frac{1}{8}$ in. respectively. The usual type of axleboxes and horns would do; but if you want to copy the special wheels, there are two alternatives. The first is to make a pattern and get some cast; the second is to build them up, and this is not so difficult as it might appear at first sight. The rims and flanges could be made as given in the previous note on "fabricated wheels," and the centres made from two circular plates with the openings drilled and filed in them and then dished, as shown in the photographs mentioned above, the whole being brazed, and then turned in the same way as a casting. If I were doing the job myself, I think I would make the rims and flanges in one piece by bending a suitable section of square steel bar into circles. The $2\frac{1}{2}$-in. gauge diameter would be $2\frac{3}{4}$ in., and for $3\frac{1}{2}$-in. gauge it would work out at $3\frac{7}{8}$ in. The coupling-rods are of the usual pattern.

**Cylinders and Motion**

On the full-sized engine the cylinders have valves on top, operated by Stephenson link-motion through rocking-shafts, the valves having outside admission. On $2\frac{1}{2}$-in. gauge you can't get four eccentrics between the two cranks without making the whole issue unduly small, and in any case it is a fiddling sort of job to get a full Stephenson link-motion, plus lifting gear and rocking shafts, between the connecting-rods of a $2\frac{1}{2}$-in. gauge inside-cylinder engine. Therefore, I recommend on this size, that the prospective "freak" builder either uses loose eccentrics, or adopts the full and complete "works" of the L.N.E.R. "J.39" type which I described at full length some years ago, and called "Mary Ann." The valve-gear on this outfit is Joy's, and gives a very satisfactory steam distribution.

On the $3\frac{1}{2}$-in. gauge size, four eccentrics between the cranks are quite a workable proposition, and the whole doings as described for "Molly" can be utilised. Turn the cylinder block up the other way; take the exhaust through the steam-chest walls, same as I described for the "Princess Royal" and other engines, and out via a drilled rib on the top of the steam-chest cover, with the blast-pipe in the middle of the rib. The eccentrics and links can be the same as "Molly's," and the weightbar shaft may be placed practically level with the top of the frame, the lifting links being lengthened to suit. The same arrangement of rocking levers may be used, but turned completely upside down to suit the overhead position of the valves. This does not affect the position of the eccentrics on the axle; the relation of eccentric to crank and the angles of advance remain the same.

If anybody fancies their skill at boring small liners and turning or grinding piston valves to suit, there is no objection to fitting them. The before-mentioned lubricator can be put in the usual place between the cylinders and the beam, and driven by a spoke-wire connection to one of the rocker arms. It would be a good wheeze to prolong one of the arms especially for this purpose. As the travel of the rocker arm varies with the amount the gear is notched up, the connection should be made to the ratchet-lever on the lubricator at such a point that it just clicks one tooth when the lever is in the middle. It will then probably click two teeth in full gear, and this is an advantage, as the cylinders can always do with an extra spot of lubricant when the engine is working hard and the steam at maximum temperature, due to the heavy blast livening up the fire and generating a few more "therms" to prevent the superheater element freezing.

**Boiler**

On the big engine, it isn't so much the boiler itself that is such an awful freak, but the way it is dressed up. Reminds me of granny in a crinoline, though I never saw her wearing one, only a photograph. The firebox is the same as the "Lord Nelson" class passenger engines, and the barrel is "short and fat" with a fairly sharp taper. On a $2\frac{1}{2}$-in. gauge engine you could utilise the "Dyak" firebox with a short taper barrel, keeping to the same arrangement of inside firebox and tubes. For $3\frac{1}{2}$-in. gauge size, the general instructions for "Molly" could be followed, but the firebox casing made larger, both in length and width, and a taper barrel applied to suit. The same arrangement of superheater would do, and there would be no need to enlarge the inside firebox in cross section, nor increase the number of small tubes unless it were especially desired; the heating surface as given for "Molly" would be quite enough to guarantee all the steam the cylinders could use. However, if anybody wants to get the biggest possible firebox, make it to conform to the wrapper sheet, leaving 3/16 in. water space at bottom all around, $\frac{1}{4}$ in. at top, and take the crown sheet $\frac{1}{4}$ in. above the centre line of the barrel at the firebox end. Increase the number of small tubes to fill up the tubeplate. Use the same arrangement of staying, as given for "Molly."

The smokebox can be circular, and rest on a saddle built up from sheet metal, as described for "Molly"; the ring and door, with dog fastening, can also be used. The

chimney on the big engine looks like a domestic pail with the handle cut off and the bottom knocked out, sunk halfway into the smokebox. This can be imitated on the small sister by softening a bit of copper tube of requisite diameter (say $1\frac{1}{8}$ in. for $2\frac{1}{2}$-in. gauge and $1\frac{1}{2}$ in. for $3\frac{1}{2}$-in. gauge) and widening out one end by driving a hardwood or metal plug into it. A small flange could be silver-soldered to the chimney at the bottom of the tapered part, and attached to the smokebox (outside) by four small brass screws, putting some plumbers' jointing under the flange to keep it airtight.

The effect of the multiple-jet blast-pipe can easily be obtained thus: Screw a ring or adaptor on top of the ordinary blast-pipe, with an external thread on it, and fit an enlarged blast-pipe cap on to this. Turn it from round rod, with a slightly domed top; and instead of a central hole, drill three small ones for $2\frac{1}{2}$-in. gauge engine, and five for $3\frac{1}{2}$-in. size; the first-mentioned in a triangle, the second in a circle. The exhaust steam coming out of the "pepper-box" cap will fill the wide chimney and do the needful. The blower can be formed of a ring of $\frac{1}{8}$-in. tube around the cap with three No. 70 holes in it for the smaller size, and four or five for the larger.

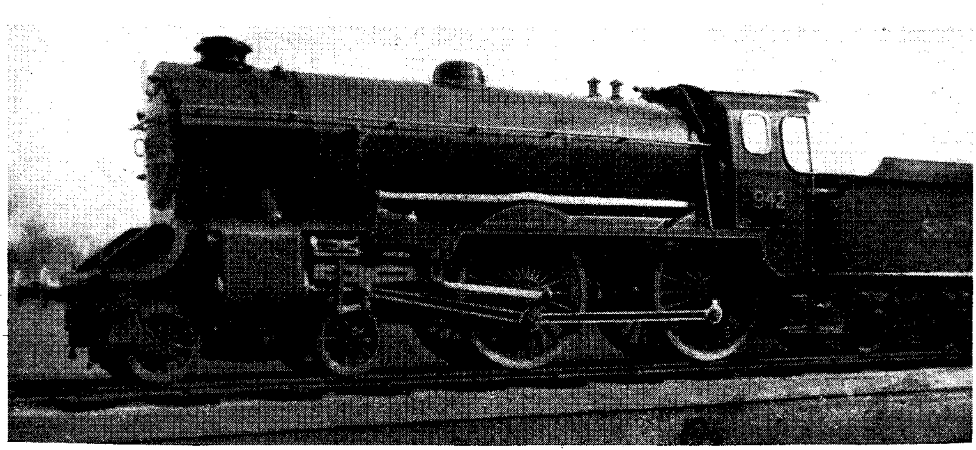
All my "standard" boiler fittings and mountings can be used. The disc-in-a-tube type regulator is about the most suitable for the low dome; and the safety valves should have large bushes ($\frac{3}{8}$ in. or $\frac{1}{2}$ in.) so that the screwed part of the valves goes well down in the steam space, to give enough room for adequate-sized balls and springs. The ball-seats are formed in the screwed portion, on account of limited headroom. The complete boiler may be "dolled-up" in the lagging sheet shown in the photographs of the full-sized engine. For boiler feed, the injector I am proposing to describe for "Molly," will do very well for both $2\frac{1}{2}$-in. and $3\frac{1}{2}$-in. gauge sizes.

**Cab and Tender**

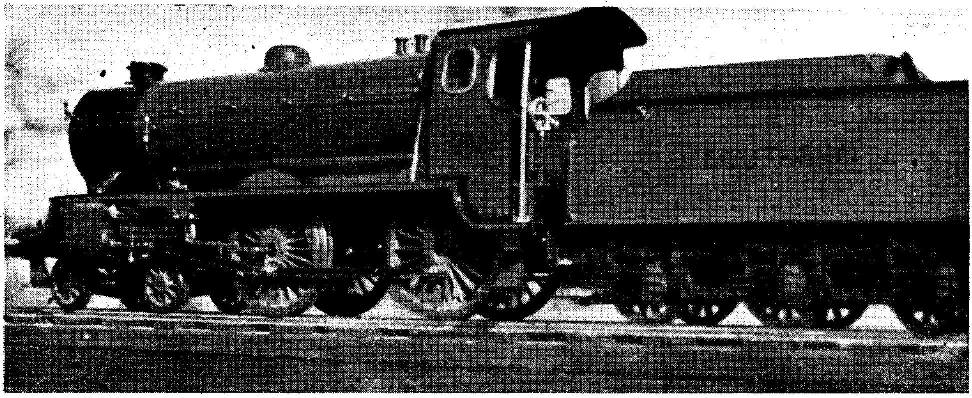
The cab of the full-sized engine is made from exactly the same thickness of material that I usually specify for $2\frac{1}{2}$-in. gauge cabs, so if any close relation of Inspector Meticulous wants to "scale" *that* down, he is on some job! Biscuit-box tin, such as I used for the "O" gauge "Princess Eva," would do fine, for either size; it might need a rib or two on each side, just soldered on inside, to prevent buckling. Angles in the corners, which might be bent up in the vice from strips of the self-material, would help to stiffen it up. Ordinary soldered joints are quite suitable.

As regards the tender, there is nothing particularly worth noting about it. The instructions I have already given for $2\frac{1}{2}$-in. gauge tenders may be followed out for either size, altering measurements and shape of sheets to suit the job in hand. Anybody who has an oxy-acetylene blow-pipe, or can get the use of one, can save bags of time and lots of labour, not to mention having a more satisfactory and stronger job, by joining the frames and buffer-beams with Sifbronze, or even brass wire. Horn-cheeks can be made from angle; and if tender wheels are "in short supply" (these "official" phrases always amuse what's left of poor Curly) they can be built up as described in a recent article.

Thin sheet brass or copper can be used for the tank, soldered joints being all that are necessary, but the soleplate, if thin, should have a stiffening piece attached where the hand pump is located. With a good working injector you don't really need a hand pump, but I usually fit one as a kind of "insurance." No pump feed and by-pass pipes are needed, the only other



**Mr. J. H. Owen's $3\frac{1}{2}$-in. gauge Southern "V."**



**On test with a borrowed tender.**

outlet from the tank being a screw-down valve at the front end, with a tail pipe to carry the "feed bag" or connecting hose for attachment to the injector feed pipe. The stem of the screw-down valve should be prolonged upwards through the soleplate, and a cross-handle fitted, similar to a brake handle, which makes it convenient to operate when the engine is running.

Well, I reckon that about covers the points raised. I don't think I would ever build one of the awful caricatures myself; and, for the life of me, I fail to see why a locomotive, even when built under weight and loading gauge restrictions, can't be made to look like a locomotive in the style we old timers learned to love and admire, instead of something that you might go to bed and dream about after finishing up the alleged meat ration with a spoonful of insipid pickles. Truly, 'tis "the swing of the pendulum" for the line that once provided me with food and shelter, at one time carried the prettiest locomotives that ever ran on any railroad, and now it has carried the ugliest!

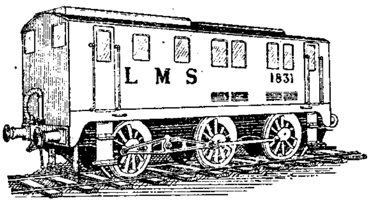
**A Contrast**

By way of contrast to the above, just take a look at the pictures reproduced here. They show a 3½-in. gauge copy of the last type of express passenger engine designed by Mr. Maunsell, the now retired C.M.E. of the Southern Railway. These engines of the "V" or "Schools" class were built with the same object in view as the above, viz., restriction on weight and height, so that they could work heavy express trains at high speed over the difficult bit of line between Tonbridge and Hastings, where there are heavy grades, sharp curves, and small bore tunnels. To the best of my knowledge and belief, they are the most powerful 4-4-0 engines in this country, having a tractive effort very little inferior to a "King Arthur" 4-6-0. They ride wonderfully well, are economical both to work and maintain, and the drivers like them very much indeed. The full-sized jobs are only spoiled in appearance by one thing, the horrible smoke-deflector plates on each side of the smokebox; thank goodness Mr. John Owen, the builder of the engine here shown, left them off his small edition.

As can be seen from the pictures, Mr. Owen has followed out the details of the full-sized engine very closely; look at the smokebox front, snifting valves, bogie, guide bars, return crank and other items. The chimney, which on many engines entirely spoils the whole bag of tricks by being either the wrong size or wrong shape, or usually both, is absolutely correct on this locomotive. The tender shown is only an odd 3½-in. gauge one used for testing; a proper tender of the right shape and size is now in hand, and this will be just as correct in detail as the engine herself. She is an excellent worker, having given a very good account of herself both on her home road, which is a simple up-and-down affair, and on the long non-stop line of the Birmingham S.M.E. Hearty congratulations on a good job well done, friend John!

In passing, here is a tip which might be useful to other locomotive builders who may have trouble in keeping an even fire all over the grate of a lengthy firebox. When Mr. Owen brought his 2½-in. gauge "Sir Menadeuke" ("King Arthur" class 4-6-0 but with Baker valve gear) for a run on my road last year, the fire would persist in going dull at one end of the box, when the engine was doing a nonstop run, well notched up, with a correspondingly light blast. I suggested to our worthy friend that he should try a sloping false bottom to the ashpan, to deflect the air stream toward the dull part of the fire, and so "even out" the draught over the whole of the grate. He has done this, and the trouble is cured.

# *Construction of Transmission Gear




By EDGAR T. WESTBURY

THE upper housing for vertical shaft is made to the dimensions shown in Fig. 112, from a piece of 1 in. by ⅜ in. rectangular bar, either brass or steel being equally suitable. The end faces must be trued up exactly square, and to a length exactly equal to the width of the bolster. The best way to machine them is to find the centre of the end faces with dividers or "jenny" callipers, and centre-drill them, so that the bar may be set between centres in the lathe and faced up.

For boring the housing, it should be clamped on the faceplate, with a couple of parallel packing strips behind it to allow the boring tool to go right through. Set the work up so that the four corners project radially exactly the same amount, which is most easily done by gripping a square-ended bar in the tool post and checking up with feeler gauges. This will ensure that the housing is exactly in the centre of the bar, much more positively than can be ascertained by ordinary methods of marking out and "working to the line." If, however, the bore of the bolster housing should happen to be out of centre, as already mentioned, due allowance must be made in setting up the bar. Of course, it is always possible to carry out corrections when the frame is assembled, by the use of packing shims on the ends of the bar and the sides of the housing, but this is a much more tedious method than taking pains to get them right in the first place.

The housing is bored out to take the race, as directed for the bolster housing, except that the hole does not go right through at the full diameter, as the race in this case is located endwise. A smaller hole, a few thousandths of an inch larger than the shaft, is drilled right through, and the face of the shoulder is relieved so that the inner ring of the ball race cannot rub against it when the latter is hard home in the bottom of its housing.

Alternatively, the housing may be bored right through to the race diameter, and a spigoted ring inserted from below and sweated or otherwise secured. Some constructors may find this easier to carry out, as it allows of using a reamer to finish the bore of the housing to correct size. It also simplifies the process of aligning the two vertical shaft housings, which should be carried out by means of a true mandrel inserted in both the bolster housing and the upper housing, for locating the latter while "spotting" the screw holes in the end faces.

In the case of the housing made as per detail drawing, the end of the mandrel must be turned down to pass through the 7/16-in. hole, and a ball-race or a truly turned dummy ring mounted on the end to fit the bore of the housing. If desired, the vertical shaft itself, with ball-races mounted on each end, may be used as the aligning mandrel, but make certain that the races are mounted on truly concentric seatings, and pulled up to the shoulders properly, so that the truth of the whole assembly is beyond reproach.

When the housing, with the mandrel in place, is located between the frame plates,

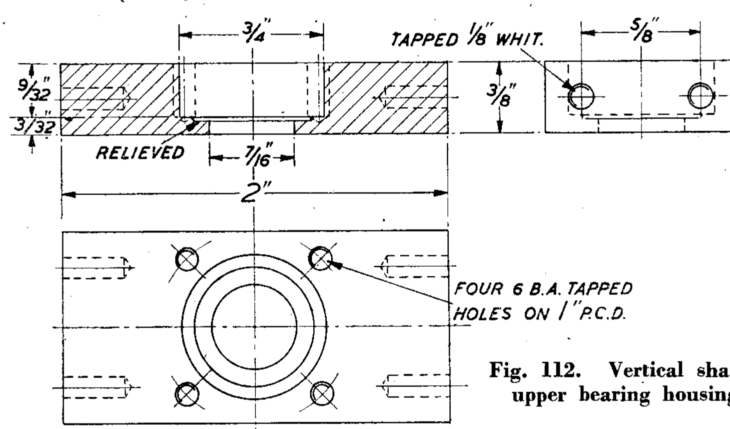



**Fig. 112. Vertical shaft upper bearing housing.**

* *Continued from page* 520, "*M.E.*," *May* 28, 1942.

a clamp should be applied over the ends to hold it in place, leaving room to spot through at least one of the screw holes with a ⅛-in. drill to locate the tapping hole. If it is not practicable to obtain access to all the holes at one setting of the clamp, one hole

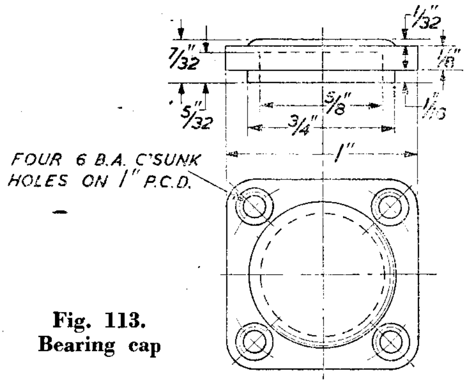



**Fig. 113. Bearing cap**

in each end of the bar should first be spotted, then drilled and tapped, and the screw put in to hold the parts in place while dealing with the other holes.

**Bearing Cap**

The object of this fitting (illustrated in Fig. 113) is simply to clamp the upper ball-race in position, and to protect the top end against the ingress of foreign matter. It may be turned from any convenient bit of bar or plate, the spigot being a push fit in the bore of the housing, and long enough to just nip the race before the outer flange face makes contact. The recess in the cap is made large and deep enough to clear the end of the shaft and the clamping nut.

Four screw holes are drilled equidistantly in the corners of the flange, and spotted through into the top face of the housing, for locating the tapping holes in the latter.

The bearing cap can be used as a very effective pressure lubricator to force grease into the ball race, in the infrequent intervals when this is desirable, simply by removing it, filling the space above the race with grease, pushing it into place again, and tightening up the four screws.

Incidentally, it may be observed that the holes in the frames for the screws securing the upper bearing housing are pitched a little higher in the detail drawing than they are in the G.A., the reason being that a little extra length of vertical shaft has been found desirable. As the room over the top of the transmission frame is not unduly restricted, it has been thought worth while to allow the bearing cap to project a little higher to allow of this slight modification.

**Horizontal Shaft Housing. (Fig. 114)**

A casting in gunmetal or iron is recommended for this part also, but it may be machined from a solid piece of 1 in. × 1½ in. rectangular bar if desired. It is not absolutely essential to cut away the top and bottom to the shape shown in the end elevation, in the latter case. The part is first held in the four-jaw chuck with the inner face outwards, and bored out to take the bearing sleeve. The internal surface of both the 1-in. diameter and 1¼-in. diameter portions should be as smooth and accurate as possible, to allow of close fitting of the sleeve. At the same setting, the end surface is faced up, but this is not necessary if bar stock is used, provided care is taken to set it up quite truly on the face. In the case of a casting, however, machining on both end faces will be called for, and the best way to deal with the outer face will be to mount the work on a shouldered mandrel.

The work is now clamped to an angle-plate

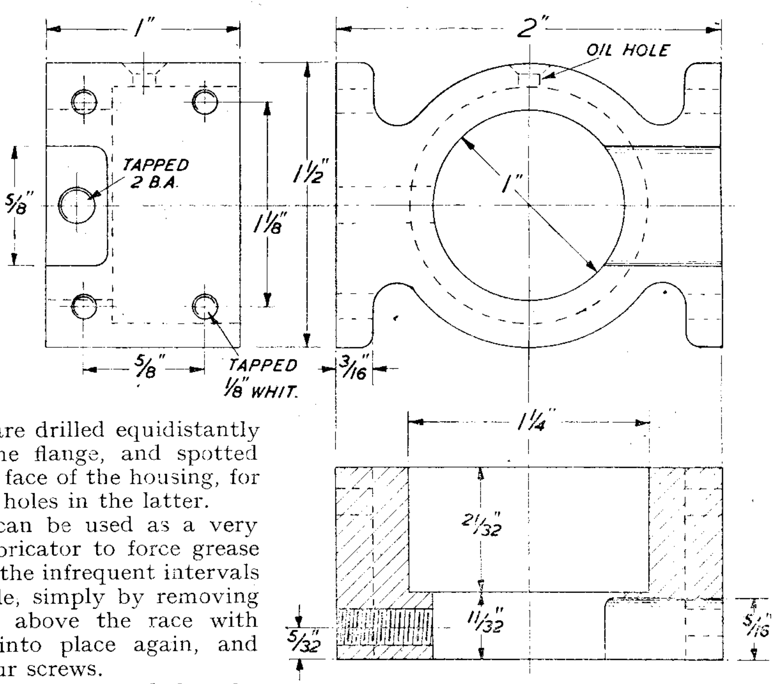



**Fig. 114. Horizontal shaft housing.**

mounted on the lathe faceplate, by means of a single bolt through the centre bore, and set truly square with the faceplate by means of a square applied to either side. In order to make certain that the bore of the housing is kept exactly central between the bolting faces, the preliminary marking-off of witness lines at exactly ½ in. from the edges of the 1-in. hole will be very helpful.

After machining one of the bolting faces, the work is turned end for end on the angle-plate, and the machined face butted firmly against the faceplate, or against a parallel packing strip temporarily interposed while the work is being bolted down. As it is only necessary to take facing cuts over these surfaces, concentric truth is unimportant when setting up, but every care must be taken to ensure that the faces are parallel with each other in both planes. The distance between them should be such that the housing will just fit between the frame plates.

The groove in one side of the outer end face may be cut out by drilling and filing or, better still, by end-milling. As previously mentioned in dealing with such operations, the best way to do this is to clamp the work to an angle-plate mounted on the cross slide, with its centre line dead horizontal at the level of the lathe centres. A home-made flat end-mill will perform the operation quite nicely. As the groove simply forms a clearance cavity for the withdrawing cam, its accuracy in respect of width and position is not a vital matter, neither is it necessary to form a radius in the bottom as shown in the drawing, if the only end-mill available is a square-cornered one. In the event of having to use a smaller diameter end-mill than ⅝ in., it will be necessary to do the job at two settings, altering the elevation of the work to suit. Those who possess a vertical slide will find this quite a simple matter, but even when nothing but an angle-plate is available, it only calls for the exercise of a little more time and trouble. I very often use an angle-plate for such jobs in preference to a vertical slide, on account of its better rigidity.

The 2 B.A. tapped hole in the side of the housing, opposite the groove, is intended for the insertion of a key, to keep the bearing sleeve from turning in the housing. It will be seen that this hole comes in line with a clearance hole in the frame plate when assembled, so its position may be marked off at the same time as that of the holes for the screws which secure the housing in position.

As in the case of the vertical shaft housing, a clamp over the outside of the frame plates may be used to hold the housing in place while spotting the screw holes. Care should be taken to set the bore of the housing exactly on the horizontal centre line of the frame; this may be checked up by setting the assembly on the surface plate, with parallel packing under the cross members of the bolster, and inserting a stepped mandrel in the bore of the housing. With the aid of a scribing block, the height of the mandrel centres at either end can then be checked, and compared with that of the centre lines on the frame plates. When the correct location of the housing is assured, spot-drill the four holes each side, drill and tap them, and secure the housing in position.

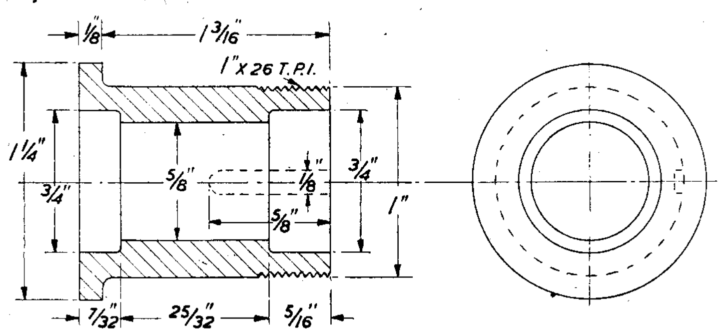


**Fig. 115. Bearing sleeve.**

**Bearing Sleeve.** (Fig. 115)

This component should be made preferably in mild-steel or cast-iron, especially if the housing is of gunmetal, in order to ensure good wearing properties. Although the sliding motion of the sleeve is very slight, it should work freely, but with the minimum possible clearance, in the housing. All parts of the sleeve must be truly concentric, and the best way to ensure this is to bore and turn as much as possible at one setting, then mount the work on a pin mandrel to finish the rest.

The centre hole should first be drilled right through, and opened out to ⅝ in. diameter with a boring tool; its exact diameter is not important so long as it is left reasonably smooth and parallel. Counterbore the end of the hole to take the ball-race, which is a SKF EE4, as for the vertical shaft, and the same observations as to fitting limits also apply. The end face and as much of the outside surface as is accessible may

also be machined, including the screw-cutting, if desired.

Turn up a pin mandrel from any odd piece of bar stock which may be handy, holding it in the four-jaw chuck for preference, as this enables it to be very firmly gripped. It should be of such a size that the ⅝-in. hole in the sleeve will press fairly tightly on, and it is also advantageous if a spigot of larger diameter to fit the counterbore for the ball-race is also provided. The pin should not project right through the sleeve, but should leave sufficient depth for counterboring the other end of the hole to take the second ball-race.

It will be noted from the assembly drawing that the outer ball-race is not located endwise in the sleeve, but is free to take up its own location, as determined by the spacing bush on the shaft. This ensures that the races cannot in any circumstances be subjected to abnormal end pressure in assembly. The inner end race, on the other hand, is located in one direction only by the shoulder of its recess, but being normally subject to end thrust, it cannot move the other way, and is therefore regarded as the "located" race. In all cases where radial type ball bearings are used in pairs, this rule of locating one race endwise and allowing the other to "float" should be rigidly observed, if satisfactory working and long life are to be assured.

A keyway ⅛ in. wide by 1/16 in. deep is cut on the side of the sleeve, running right through the threaded part and out to the end. This can be carried out by end-milling, the sleeve being clamped to an angle-plate by a bolt through the centre, and the latter mounted on the cross slide, in this case, *parallel* to the lathe axis. Care should be taken to set the work so that its centre is level with the lathe centres, which is most readily done by measurement from the cross slide, using a pair of inside calipers. If the exact height of the centres over the cross slide is ascertained, it is necessary to deduct half the diameter of the sleeve from this figure, and set the calipers accordingly.

**Lock-nuts.** (Fig. 116)

It is best to make these of steel, machining them from a bar or hollow billet and parting-off with a keen parting tool. If desired, they may be made both of the same diameter, but the two different sizes facilitate manipulation, especially as this can only be done properly by the simultaneous use of two C-spanners.

Should it be necessary to face the backs of the nuts after parting-off, they may be screwed on a suitable mandrel, or on the sleeve itself, for this operation. But with care in parting-off, it should not be necessary to do more than remove the burr at the centre with a half-round scraper and then rub down the surface on a sheet of emery cloth laid on the surface plate.

The six slots in the edge of each lock-nut may be end-milled by clamping each in turn to the face of an angle-plate, at centre height, and turning them one-sixth of a revolution between each cut. It is advisable to mark the exact position of each notch beforehand, for although precise spacing is not important from the utility point of view, irregularity in this respect looks very bad. Constructors who possess a milling spindle may mill out the slots before parting the nuts off; or they may be planed out by means of a suitable tool held in the tool post, and operated by racking the lathe saddle backwards and forwards.

If desired, a keep washer may be interposed between the two lock-nuts when they are assembled. This consists of a sheet steel washer, made from about 20 g. material, having a tag to engage the keyway in the sleeve. It will be found that this is a great help in locking the nuts securely, and even more so if, after adjustment, the outer edge of the washer is bent down into one of the slots in either lock-nut with a nail punch.

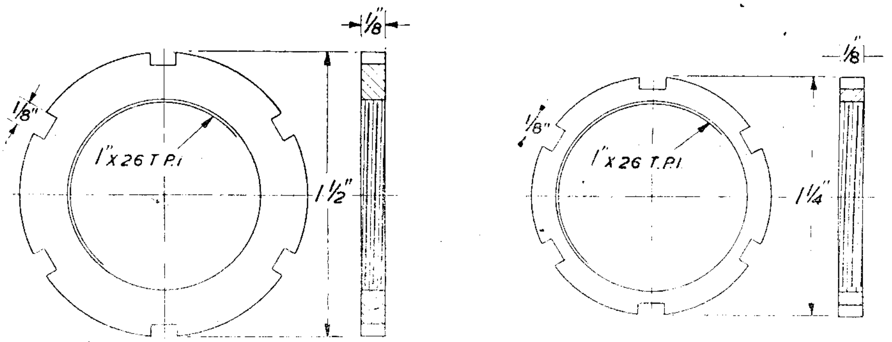



**Fig. 116. Bearing sleeve lock-nuts.**

*(To be continued)*

# Letter

### The 17-Hole Division-plate

DEAR SIR,—Surely if "M. W. Bramley" has followed with interest all the articles relating to the problem of the 17-hole division-plate he would not have asked the question at the end of his letter, for was not the spirit of the competition to see what gadgets and contraptions the model engineer could devise with his own thinking.

It's all very well to say use the lathe and wheels required, but how does one go on if one hasn't suitable wheels.

I have no 17-wheel or any multiples of it on my lathe, so what can I do if I am asked to make a plate, the same as I do now, when I have to divide 19-in. diameter discs into 24 parts? Work it out I expect.

It's no good trying to do them on the lathe, for as it is, it will only swing 18½ in. in the gap.

All the same, I was very interested in the various articles as they appeared, the same as I am with nearly all that appears in THE MODEL ENGINEER, but I cannot pretend to be a model engineer at all.

Yours truly,

Maidstone. W. J. POILE.

# Clubs

### The Society of Model and Experimental Engineers

There was an attendance of 27 at The Stationary Engine Meeting held in the Workshop on Monday, 18th May, 1942. Mr. H. R. Hadlow, of Guildford, and Mr. R. S. Waddington, of West Drayton, were elected to membership. Several models were run under steam from the Society's boiler. Certificates of merit were awarded to Mr. D. H. Harris for his twin-cylinder single-acting enclosed steam engine, and to Mr. S. W. Simpson for his oscillating condensing steam engine and boiler, of which he gave particulars regarding the design and building in the course of the evening. Secretary, H. V. STEELE, 14, Ross Road, London, S.E.25.

### Norwich and District Soicety of Model Engineers

At the General Meeting of the Society held on May 21st, one of the completed N. & D.S.M.E. lathes was on view.

Mr. S. Hines, a well-known Norwich machine tool maker and a member of the Society, offered at the outset a prize of two guineas to the member who completed the first lathe, but as the six members have made them collectively, Mr. Hines has very kindly given the money to the Society's fund in appreciation of the very fine workmanship and design.

Afterwards, Mr. H. J. Wyatt explained and gave a working demonstration of his model of the "Lound" beam engine which he has just completed.

The President, in proposing a hearty vote of thanks to Mr. Wyatt, commented on the accuracy necessary for the efficient working of the model, which was fully endorsed by all members present.

Hon. Sec., J. POWELL, 29, Spinney Road, Thorpe, Norwich.

### The Glasgow Society of Model Engineers

Regattas and track days being at present impossible, the G.S.M.E. have arranged an indoor "Live Steam" day. for Saturday, 13th June, 1942, at the Club Rooms, 143, West Regent Street, Glasgow. Our Edinburgh Society friends have promised their support, and between 2.30 to 10.0 p.m., we hope to run several 2½-in., 3½-in., and 5-in. gauge locos., some two-stroke and four-stroke speed -boat engines, several sets of turbines with Prony brakes and a flash steam speedboat engine, also on the brake. A compressed-air plant will be available. Any members having plant or models, whether working or not, finished or unfinished, are asked to bring them along and help make the day a success.

Hon. Sec., Mr. J. SMITH, 785, Dumbarton Road, Glasgow.

### The Kent Model Engineers Society

As already mentioned, the meetings of the Society will be held in future on Tuesday evenings, at 7.30, at headquarters, Sportsbank Hall, Sportsbank Street, Catford, S.E.6, instead of Sunday mornings as in the past.

On June 16th, Mr. Thorne will talk on how he started Model Engineering.

On June 23rd there will be a short practical demonstration on lathe work by Messrs. Coleman, Davidson, and Cook.

On June 30th, Mr. Davidson will lecture on "Making a Small Lathe."

Hon. Sec., W. R. COOK, 103, Engleheart Road, S.E.6.


## NOTICES.

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written, and should invariably bear the sender's name and address.

**Readers desiring to see the Editor personally can only do so by making an appointment in advance.**

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